Getting the most from "Critical Airflow" (VAV) Control Systems

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What is a VAV System?

- Any system where airflows are balanced (adjusted) dynamically in real-time
- They are the opposite of constant volume systems which are balanced once and then left alone
- Because of the impact on safety, they are referred to as "Critical Airflow Controls"
- Comment: How many constant volume systems are really constant?

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About Variable Air Volume Control Systems-

- Principal goals are to
  - Reduce energy over life of building
  - Reduce capital cost
  - Provide flexibility over the life of building
  - Improve worker safety
- VAV Systems typically come in two types;
  - Full VAV; airflows are automatically adjusted over entire range of operation
  - Two Position; airflows are set at either high, or low values. Occupancy or use are most common "toggles" used to switch modes.

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About Variable Air Volume Control Systems-

- Having been around for almost 15 years, the use of VAV in lab applications is widely accepted
- In the past decade, most new laboratory projects utilize some means of modulating (adjusting) airflow
- >$100M of Specialized “Critical Airflow Control” hardware manufactured annually for labs
- Evidence shows users often feel they are not getting the energy savings expected

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In this presentation we will discuss-

- Why “automatic” fume hood controls do not automatically save energy
- What factors often work against saving energy in lab buildings
- Why safety and energy conservation goals harmonize so well
- How to utilize control features hidden in your system
- How to use data available from the **B**uilding **A**utomation **S**ystem to optimize performance.
- How to get expert help; online and real-time.

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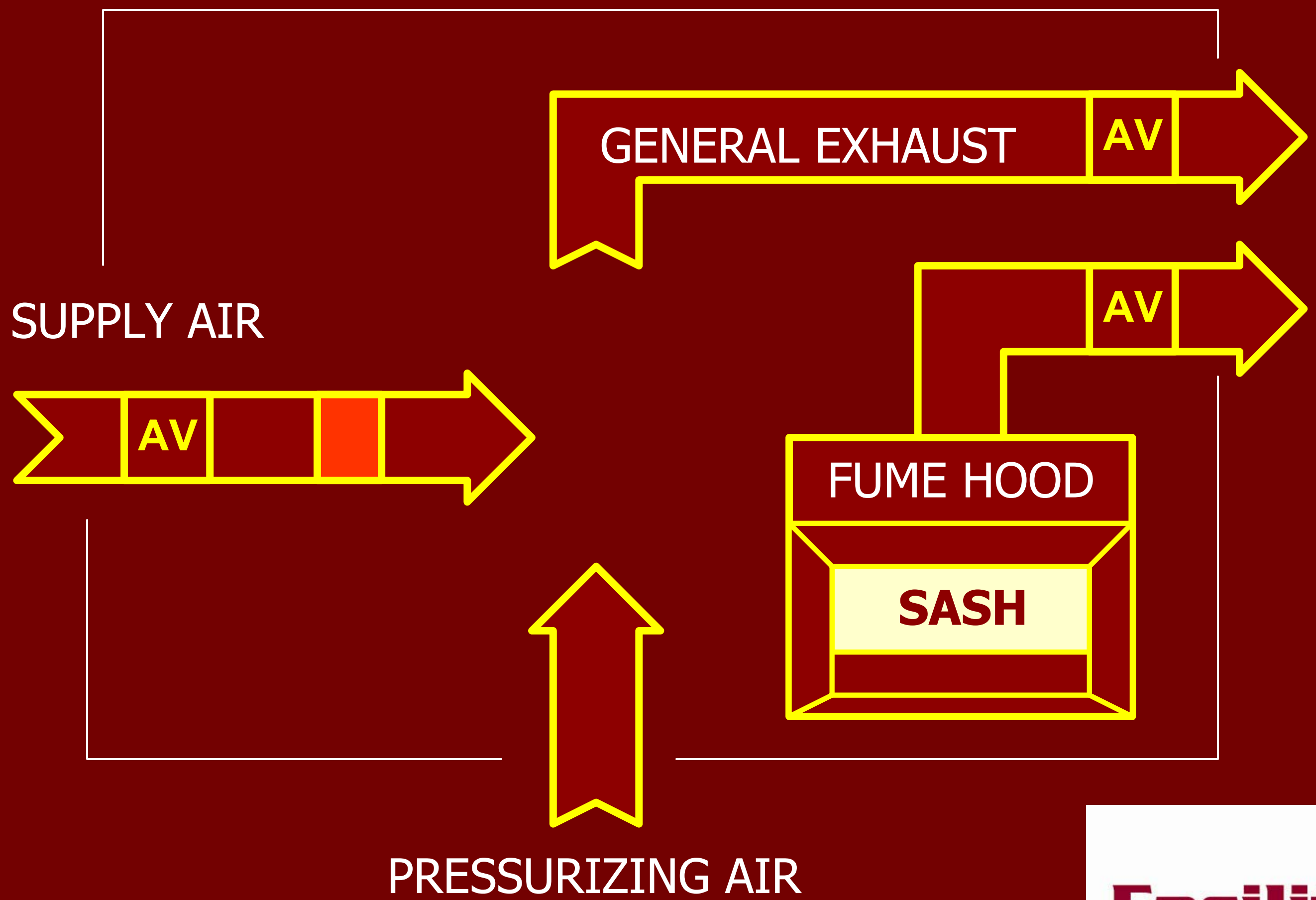
Review of VAV Lab Basics-

- Air flow through Lab



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Understanding the Three Airflow Drivers-

- Minimum Air Changes
  - Safety Requirement
- Supply Air for Cooling
  - Comfort Requirement
- Supply Air for Hood Make-Up
  - Needed to replenish air exhausted by fume hoods

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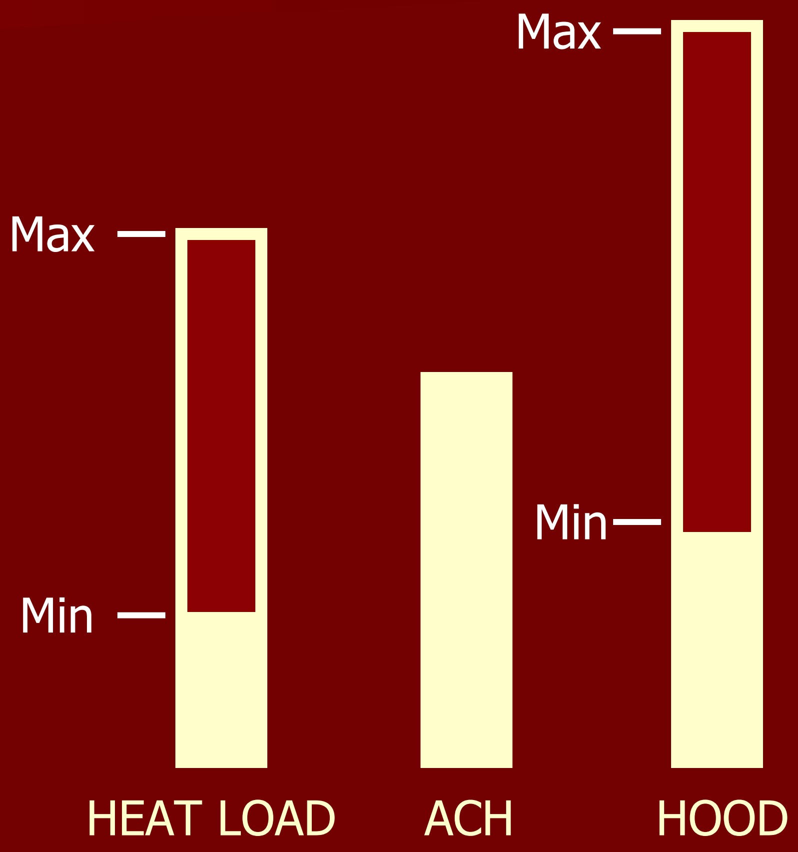
Lab Airflow Conditions-

- Small Room
  - 300 to 400 Sqr. Ft.
  - 10 to 12 ACH
- Large or Multiple Fume Hoods
  - 2, 8 ft Bench, 1250 ea.
- Moderate Heat Load
  - 3 to 15 Watts/Sqr. Ft.
- Good application



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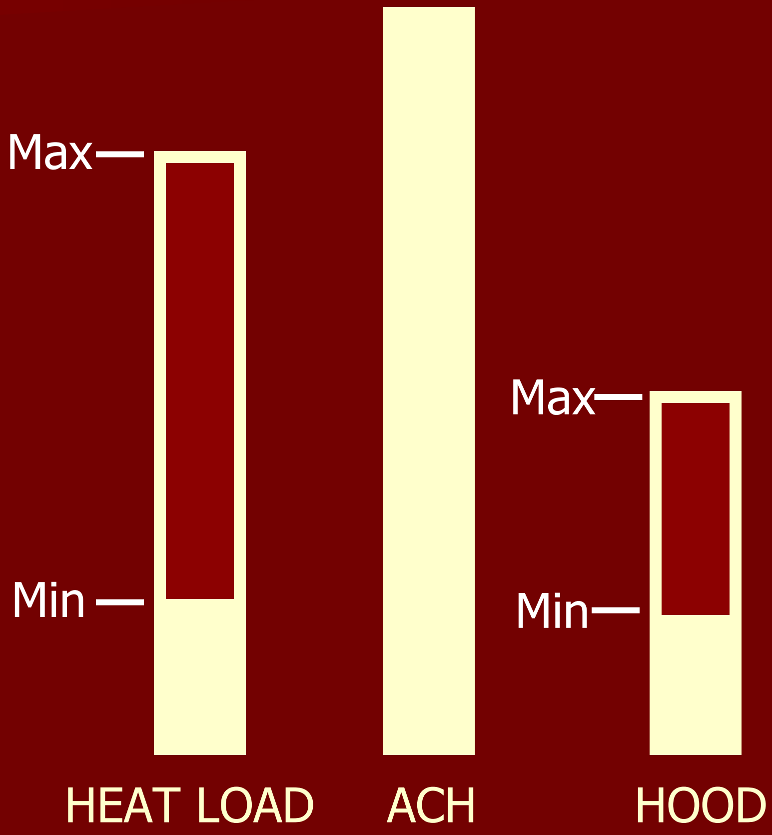
Lab Airflow Conditions-

- Large Room
  - 1000 to 2000 Sqr. Ft.
- Small Fume Hood
  - 1, 4 ft. Bench at 600
- Low Heat Load
  - 3 to 10 Watts/Sqr. Ft.
- Poor application



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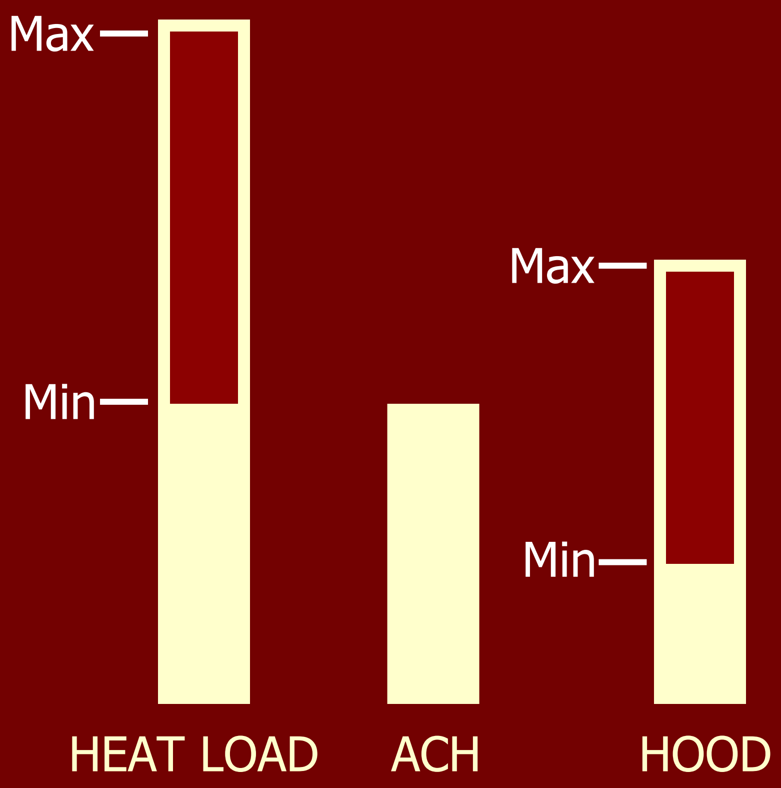
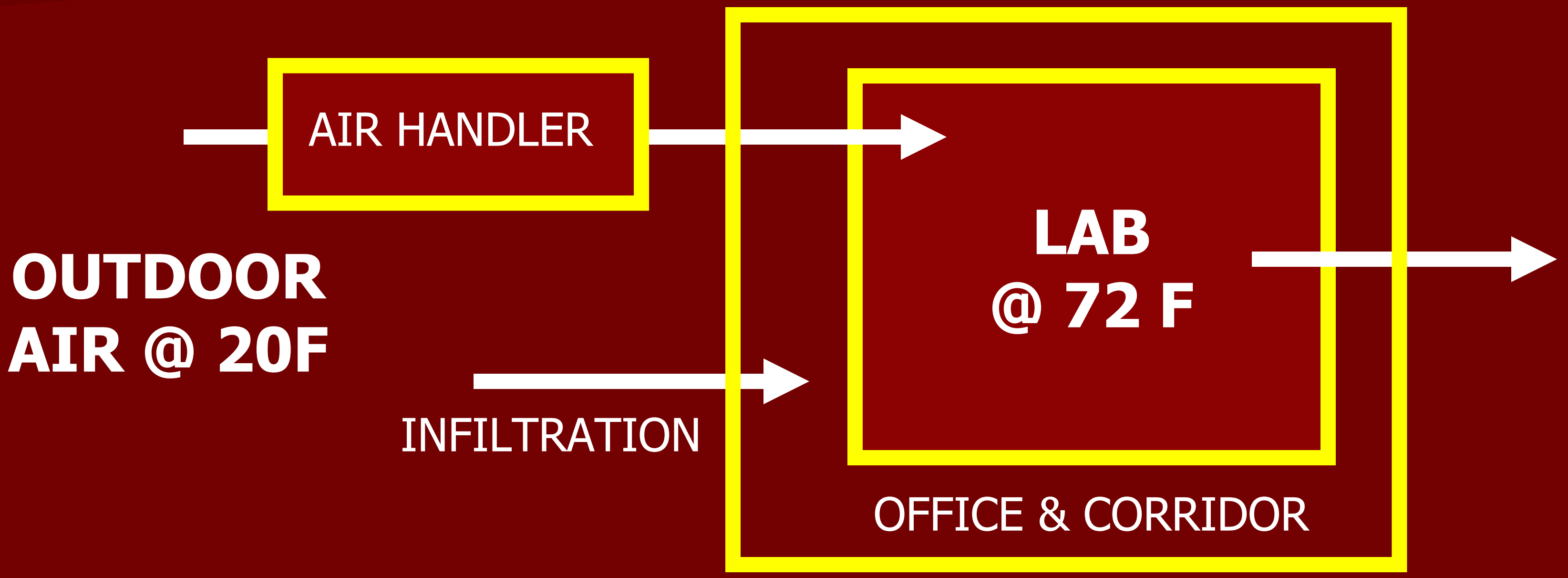
Lab Airflow Conditions-

- Small Room
  - 300 to 400 Sqr. Ft.
  - 10 to 12 ACH
- Small Fume Hood
  - 1, 6 ft Bench, 850 ea.
- High Heat Load
  - 10 to 30 Watts/Sqr. Ft.
- Good application



Infiltration air isn't free!



- Either way it costs the same
- Choose comfort…… or complaints!

Factors that work against meeting energy goals-

- Fume Hood Habits
  - People leave sashes open
    - During periods lab is occupied, while not at hoods
    - During unoccupied periods
  - People use hoods with sashes wide open
- Excessive Fume Hood Exhaust Air
  - Maximum airflow determined at wide open sash rather than at "working height"

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Factors that work against meeting energy goals- *........continued*

- High heat loads in labs
  - Need for supply air for cooling eats into VAV fume hood savings
- Exhaust consumers are added without regard to where the air they need will come from
- Attitudes- the idea that safety and energy conservation impede creativity!

Safe Practices are Green Practices-

- These practices are supported by every standard and guide on the safe use of fume hoods-
  - Sashes are wide open only during setup and tear down of experiments
  - Glass panels are to be positioned between the experiment and the worker’s breathing zone
  - Sashes are to be closed when the user leaves the front of the hood

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Supporting "Sash Management"

- Develop a plan jointly with Safety, Facility, and R&D department management
- Educate and Train
  - Safe hood use practices
    - Sash use
    - Experiment setup
  - Energy conservation
    - Most researchers haven't a clue how much it costs to feed a hood air

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Sash Management *....continued*

- Use Sash Stops
  - – Place stops (which can be overridden) at desired working height of sash
- Maintain Sashes
  - – Clean the sash glass periodically so it remains transparent
  - – Maintain counterweight systems and clean sash tracks for smooth sash movement

Sash Management *....continued*

- Using fume hood controller features that you already bought
  - Reduce maximum airflow to CFM needed to get 100 FPM at sash stops
  - Set face velocity alarm to trigger when sash is raised a few inches above stops (need mute)
  - Use sash position sensor to alarm on excessive open area (need mute)

Sash Management *....continued*

- Other ideas
  - Sticker hoods with reminders about proper use of sashes
  - Mark sash positions with yearly cost to operate the hood
  - Develop a “Safety Agreement” specifying owner and user responsibilities; to be signed by both

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Dealing with High Heat Loads

- Evaluate the sources of heat and determine the largest producers
- Where heat producing devices have exhaust connection, use “elephant trunks”
- Relocate general exhaust grilles over heat sources; i.e.: refrigerators in biology labs
- Consider capture hood over uncontrolled sources

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Additional Ideas

- Use "Unoccupied" settings during off hours-
  - Reduce minimum air change rate
  - Let room temperature setpoints "float"
  - Raise air handler cooling coil discharge temperature
- Add a "high energy" use alarm, triggered by excessive hood make up requirements

Using BMS Data to Maximize Energy Savings

- Most systems available today can record a wealth of data
  - Individual hood sash heights and exhaust volumes
  - Total lab exhaust volumes
- Consolidating the data is the difficult part because there is so much data
- The reason most people don't use data is they don't know how

BMS Suggestions

- Totalize (Integrate) Lab Exhaust on a monthly basis
- Establish target airflow volumes based on best practices
- Monitor actual use against targets
- Require retraining of offenders
- Controversial but done:
  - Charge back budgets of offenders

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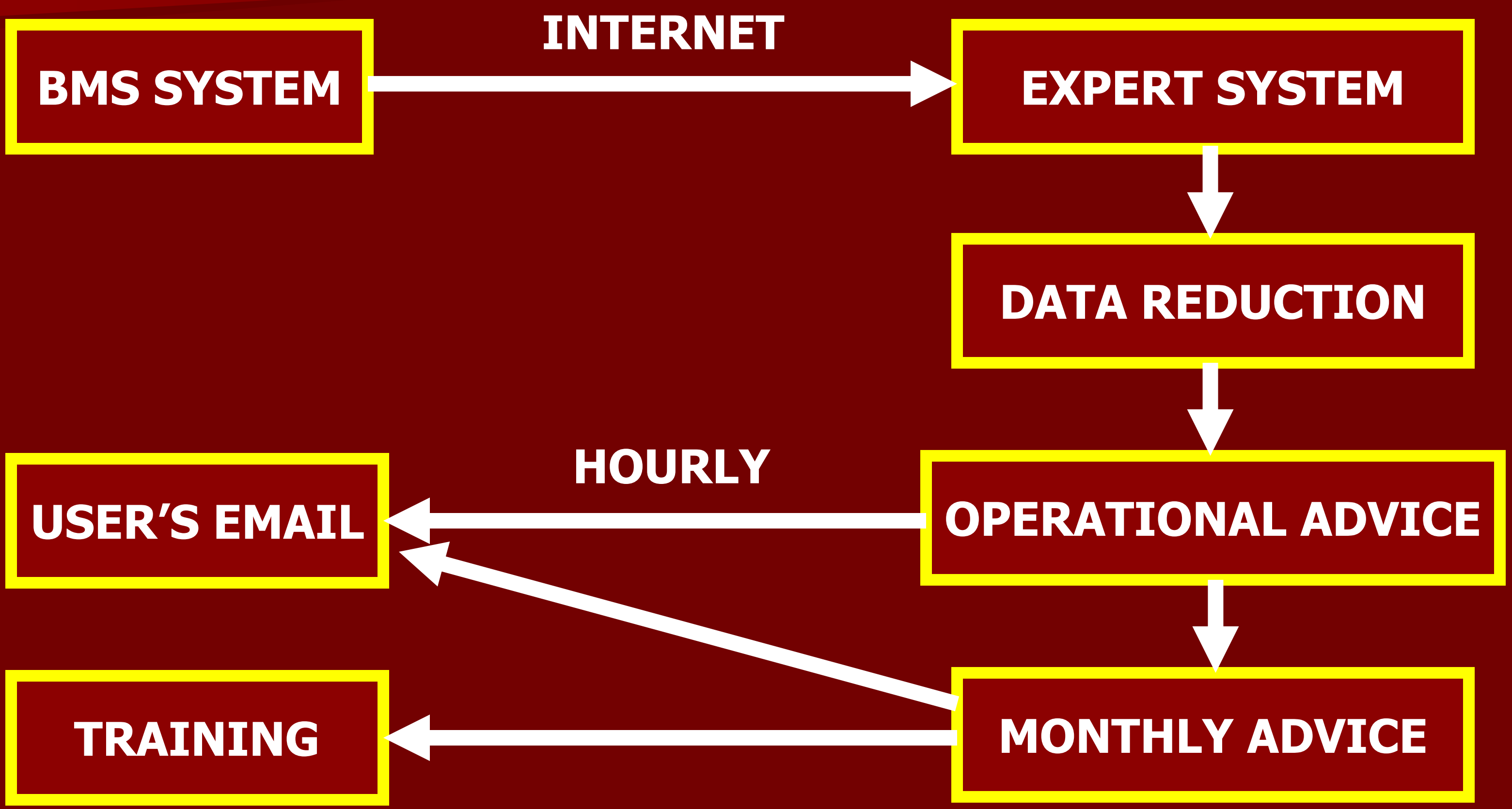
Full Time Expert Help

- The ability to "tap-in" to the BMS using the internet, now makes it easy to get expert help
- Services are available which
  - Automatically pull data from your system
  - Perform data crunching and real-time analysis
  - Benchmark energy use against "best practice" models and other users
  - Generate user advisories and reports

Internet Service Model



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Internet Service Model

- Data Retrieval
  - Data transferred every 15 minutes
- Data Reduction
  - Exhaust use analyzed
  - Cooling requirements analyzed
  - Weather data projected
  - Operating conditions compared to model
  - Optimum setpoints determined
  - Update model

Internet Service Model

- Hourly Operational Advice
  - Exhaust requirements compared to optimal
  - Continuous (not changing) high exhaust users
  - Cooling requirements; latent and sensible
  - Supply air set points
  - Static pressure setpoints
  - Control problems

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Internet Service Model

- Monthly Reports
  - Energy use vs. Plan vs. Optimum
  - Energy use by User, or Department
  - Suggestions to reduce energy
  - Plan for upcoming month, based on TMY data
- Training
  - Direct safety and energy awareness training at problem areas. Training can be delivered via Internet

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In Summary-

- Critical Airflow Control Systems save energy; but are the means, not the end.
- Purchasing the system is the beginning, not the end of the road to energy savings
- Understanding how lab ventilation systems are intended to work is the key to getting the maximum energy savings

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In Summary-

- Safety and Energy conservation goals are symbiotic and should be presented together in accordance with a unified plan
- Now, expert advise is available via the internet to help you get the most from your system.

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